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Summary Report of

**UTILIZATION
RESEARCH
and
DEVELOPMENT**

Fiscal Year 1966

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C. February 1967

CONGRESSIONAL DIRECTIVE

This report is submitted in further response to the request made by the Committee on Appropriations in its report to the Senate on the Agricultural and Farm Credit Administration Appropriation Bill, 1960 (Report No. 330). This request, on page 4, paragraph 3 of the report under section entitled "Utilization Research," states:

"Further, the committee specifically requests that it be kept advised by an annual summary report on research developments, including the work in progress at these laboratories, proposed new work, and on projects to be discontinued due to completion of work or lack of results with the reasons for discontinuance. It is the hope of the committee that it will be kept better advised not only as to the specific accomplishments in the field of utilization research but also as to fiscal requirements at these installations."

Previous reports concerning the utilization research activities of the Department, made in compliance with this request, have been submitted for Fiscal Years 1959, 1960, 1961, 1962, 1963, 1964, and 1965.

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

SUMMARY REPORT OF UTILIZATION RESEARCH AND DEVELOPMENT

Fiscal Year 1966

I AIM AND OPERATION OF UTILIZATION RESEARCH

Utilization research aimed at expansion of agricultural markets and reduction of processing and distribution costs can increase farm income, benefit domestic consumers, and contribute in U.S. programs to assist developing countries. These efforts help bring balances between supply of and demand for farm commodities. To accomplish these objectives, the USDA utilization research and development efforts are directed to: (a) devising new, easy-to-prepare food products that are attractive, economical, and fit the distribution requirements in world-wide market channels; (b) improving functional properties of natural fibers such as cotton, wool and mohair -- to better meet consumers' needs; (c) developing more economic and more suitable processed feed products needed in the expansion of the poultry, dairy, and livestock industries; and (d) seeking broadened and profitable industrial uses for agricultural materials.

The Department's utilization research investigations in Fiscal Year 1966 were conducted primarily in Federal facilities consisting of four regional laboratories (Albany, Calif.; Peoria, Ill.; New Orleans, La.; and Wyndmoor, Pa.) and twelve field laboratories (Beltsville, Md.; Washington, D.C.; Waltham, Mass.; Lexington, Ky.; E. Grand Forks, Minn.; Olustee and Winter Haven, Fla.; Raleigh, N.C.; Weslaco, Tex.; Pasadena, Calif.; Honolulu, Hawaii; and Puyallup, Wash.) in the United States. Research is done also through contracts, grants, and memoranda of understanding with State Experiment Stations, universities, and industry. Other supporting research is accomplished in research institutions of nineteen countries in Europe (14), Asia (3), South America (1), and Australia (1), through funds generated by the P.L. 480 program (Agricultural Trade and Development and Assistance Act of 1954, 83rd Congress, 2nd Session).

II MAKING UTILIZATION RESEARCH INFORMATION AVAILABLE

More emphasis is being placed on making the various segments of the agricultural industry knowledgeable of progress being made in utilization research. This effort goes beyond mere availability of information, and is directed to make the know-how useful to each particular group and organization. A summary of the various ways used in F. Y. 1966 to make known the UR&D progress is:

66	patents obtained
887	research papers published
921	speeches, press releases, and appearances on radio and television
45	formal conferences with industry
21	public-service exhibits
7,400	technical visitors to UR&D installations

Making known the progress and program of the utilization laboratories is a two-way avenue. On one hand the divisions make available their technical-economic findings, and at the same time the divisions seek to learn the developments and direction of interest of outside groups concerned with processing of agricultural materials. These are continuing efforts. Many national trade and industry organizations collaborate with UR&D to sponsor periodic meetings for the purpose of exchanging ideas and to seek better answers to processing problems.

Rural Areas Development Program

During F. Y. 1966 there was an increased effort by all of the UR&D Divisions to assist rural communities to evaluate the opportunities for establishing agricultural processing plants and to furnish technical and other information related to processing plant considerations. Typical examples of this assistance included manufacture, or contemplated manufacture, of new or improved products such as: apple cider (Wisconsin, Michigan); sorghum and maple sirups (Georgia, Kentucky, Pennsylvania, Michigan); dehydrated alfalfa products (Montana, Texas); abrasives from corn cobs (Indiana, Ohio, Illinois); paper utilizing wheat straw (South Dakota); cotton batting (Mississippi); peach products (Georgia); sweetpotato products (Louisiana); castor meal (Texas); egg products (California); sunflower seed products (Minnesota).

One of the most valuable contributions UR&D makes in the rural areas development program is to help communities evaluate the practical aspects of establishing an agricultural processing plant. UR&D has been particularly effective in helping formulate plans for short-term feasibility studies, in evaluating the findings of such studies, and in planning a specific project tailored to fit the feasibility findings.

Utilization Research Illustrative Materials

A wide variety of special exhibits and industrial movie films were made and shown during F. Y. 1966. These were used to inform agricultural and related industries of USDA developments of new food, fiber, and industrial products made from agricultural sources and of research to solve basic problems affecting use of agricultural materials. Illustrative examples are:

Group Concerned	Subject	Location
Vermont Consumers Day (University of Vermont)	New fruit, vegetable, and dairy products (exhibit)	Burlington, Vermont
Lakeview Center for Arts & Sciences (permanent exhibit)	Utilization research recent developments	Peoria, Illinois
Public Service TV Spot (P-5747)	"Toward Better Highways" - showing protection of concrete by USDA's linseed oil treatment	TV Public Service (National TV Showings)
University of Missouri	Durable press treatments for cotton	Columbia, Missouri
South Carolina State Fair	New cotton finishes	Greenville, S.C.
New Mexico State Fair	New cotton products and finishes	Albuquerque, New Mexico
Industry and technical organizations	"WORLD Wheat" (bulgur product) - (movie)	Industrial meetings (national)
Agricultural industry	WURLAN wool; cotton-wool blends	Washington, D.C.
Michigan Cooperative (University of Michigan)	New fruit, vegetable, and cereal products	East Lansing, Michigan
Am. Soc. Heating, Refrigerating, & Air-Conditioning Eng. meeting	New freeze processes for vegetables	Houston, Texas
American College of Allergy meeting	Improved procedures for determining human allergy as may be related to agricultural products	Chicago, Illinois

Formal Conferences with Industry and Other Outside Organizations

A number of formal conferences were sponsored by UR&D laboratories or jointly with industry and other organizations. The following examples are typical of the representation and geographic locations:

Conference	Sponsors	Attendance	Location
4th National Conference Wheat Utilization Research (November 3-5, 1965)	NU, WU, and other USDA agencies; Great Plains Wheat; Idaho State Wheat Growers Assoc.; Idaho Wheat Commission; Univ. of Idaho; Western Wheat Associates	98	Boise, Idaho
Annual Joint Conference of Cooperative Soybean Oil Mills and Cooperative Cottonseed Oil Mills (March 7-9, 1966)	NU, SU, FCS of USDA; and cooperating oilseed mills	200	El Paso, Texas
N. Central Agr. Expt. Stations Collab. Conference on "Aflatoxin and Other Mycotoxins" (March 15-16, 1966)	NU; North Central Agr. Exp. Stations	73	Peoria, Illinois
National Flaxseed Processors Assoc. Linseed Oil Technical Committee (March 17-18, 1966)	NU; National Flaxseed Processors Association	13	Peoria, Illinois
Lo-cal Peanut Meeting (July 27, 1965)	SU; peanut processors	112	New Orleans, Louisiana
1965 Conference on Citrus Chemistry and Utilization (October 13, 1965)	SU; citrus industry representatives	126	Winter Haven, Florida
Conference on Peach Processing and Utilization (January 17-18, 1966)	SU; Exp. Sta. and Coop. Ext. Service of Ga.; Ga. Peach Commission; Ga. Peach Council; Ga. Cannery Assn; Ga. Dept. of Industry and Trade; National Peach Council; Econ. Dev. Adm.	218	Experiment, (Griffin) Georgia

Formal Conferences with Industry and Other Outside Organizations (cont'd)

Conference	Sponsors	Attendance	Location
Sixth Cotton Utilization Research Conference (April 20-22, 1966)	SU; cotton products manufacturers and trade associations	269	New Orleans, Louisiana
Fifth Annual Meeting of Plant Phenolics Group of North America (August 22, 1965)	WU; Plant Phenolics Group of North America	100	Albany, California
Technical Alfalfa Conference (November 17, 1965)	WU; American Dehydrators Association	65	Lincoln, Nebraska
Northwest Cannery and Freezers Association (January 9, 1966)	WU; NW Cannery & Freezers Association; State Experiment Stations	1000 (Approx.)	Seattle, Washington
National Apple Industry Utilization Conference (March 23-25, 1966)	WU; EU; Crops Research (ARS) and Fed. Ext. Ser. of USDA; University of Maryland; National and International Apple Assn.	140	College Park, Maryland
Fifteenth National Potato Utilization Conference (July 21-23, 1965)	EU; Red River Valley Potato Growers Assn.; United Fresh Fruit & Veg. Assn. (Potato Divn.); Univ. of Minnesota; N. Dak. State University	165	Red River Valley, Grand Forks and Fargo, North Dakota
Research Sub-Committee of the Cigar Manuf. Assn. of America (Aug. 17, 1965 & May 10, 1966)	EU; Cigar Manufacturers Association of America	7	Wyndmoor, Pennsylvania
Sixth Triennial Maple Conference (October 19-20, 1965)	EU; maple sirup processing industry	140	Wyndmoor, Pennsylvania
Seventh Milk Concentrates Conference (October 26-27, 1965)	EU; American Dry Milk Institute; Evaporated Milk Association	200	Philadelphia and Wyndmoor, Pennsylvania

III COOPERATIVE RESEARCH WITH OTHER ORGANIZATIONS

Cooperative work with other groups is undertaken to develop new products, to improve existing products and processes, to devise economic processes for product manufacture, to evaluate products and processes, and to explore new outlets for agricultural products. These cooperative efforts contribute to early commercialization and broadened usage. Examples of cooperative research and development are:

Project	Cooperators with USDA UR&D
Improved cotton fabric structures for men's trousers and dress suits	Cotton Producers Institute
High-calorie fat emulsions for intravenous feeding	U. S. Army Medical Research and Nutrition Laboratory
Pure culture fermentative processing of cucumbers and other vegetables	North Carolina Exp. Station, Michigan State Exp. Station, and Pickle Packers International, Inc.
Pelleting characteristics of high-fiber alfalfa fractions	Nebraska Dept. of Agriculture and Economic Development
Cotton-wool blends for durable press garments	The Jantzen Company
Plant-scale evaluation of USDA process for de-allergenizing castor meal	Baker Castor Oil Co. and Plains Cooperative Oil Mill
Improved safflower processes	J. G. Boswell Co. and Anderson-Clayton
Plant-scale evaluation of USDA process for pasteurizing egg white	Pacific Growers Cooperative
Control of <u>Byssochlamys fulva</u> (mold) in grape juice	National Cannery Association
Linseed oil products for covering and protecting concrete	U. S. Bureau Public Roads; U. S. Army Corps of Eng.; Texas Highway Dept.; Kansas Highway Dept.; Illinois Highway Dept.; District of Columbia, Department of Highways

III COOPERATIVE RESEARCH WITH OTHER ORGANIZATIONS (continued)

Project	Cooperators with USDA UR&D
Stability studies of Osmovac dried fruits in dry cereals	Kellogg Company
Curing smoked meats with high-flavor maple sirup	Swift and Company
Evaluation of new dehydrated mushroom products	American Mushroom Company and the Kennett Canning Company
Studies to improve lye-peeling of apples	Southern Packing Company and Knouse Foods Cooperative
Improved meat products through microbial lipase studies	University of Connecticut
Investigations to better utilize animal protein residues	Fats and Proteins Research Foundation
Evaluation of alpha-sulfo-fatty acid esters developed by USDA from animal fats	Lehigh University
Survey of microorganisms in wheat flours related to milling practices	Millers National Federation
Investigations of crambe meal for ruminant feed products	University of Nebraska
Utilization of wheat in pulp and paper products	Washington State University
Improved processes for Crambe oilseed (new crop)	Pacific Vegetable Oil Co., Inc.; Southern Indiana Agr. Improvement Assn.

IV PROGRAM MODIFICATION TO MEET CHANGING NEEDS

Planning and Advisory Activities

The U. S. Department of Agriculture program to find new and better ways to utilize farm products is based on extensive planning, continuous reviewing of results, and modification of these many efforts to reflect current objectives. These program activities take advantage of the findings and cooperation of many organizations and individuals both within and outside the Department of Agriculture.

The Deputy Administrator, administrative staff, and directors of the four utilization research and development divisions are responsible for policy and planning. The Product and Process Evaluation Staff, composed of professional specialists, assists this administrative group in evaluating the commercial feasibility and general appropriateness of proposed and existing utilization research projects. Guidance and information is sought from various sources both within and outside the Department. Among these are special consultants who are authorities in particular fields.

A National Program of Research for Agriculture. In accordance with a directive by the Committee on Appropriations (Senate Report No. 156), in 1965-1966 a joint study was made by representatives of USDA, State Agricultural Experiment Stations, and the land-grant colleges to examine fully each and every line of agricultural research conducted by the Department and by the State Experiment Stations. This report, entitled "A National Program of Research for Agriculture", essentially completed by the end of F. Y. 1966, may well become a blueprint for guiding agricultural research for years to come. Outstanding contributions of this study include appraisal of the present status of agricultural research and definition of the future needs in agriculture.

Committee on Agricultural Science. An advisory group, established in 1962, of 16 eminent scientists representing such disciplines as biochemistry, physiology, rural sociology, marketing, and economics. This group, which includes representatives of state universities and experiment stations, renders judgment on the quality of research and on the factors essential to a favorable scientific environment, and makes recommendations concerning USDA research in basic sciences.

Agricultural Research Planning Committee. A 15-member advisory committee established in 1964, composed of USDA director of Science and Education; six representatives from research agencies of USDA; six representatives of or nominated by State universities and land-grant colleges; one member nominated by the National Academy of Sciences; and one member nominated by the Office of Science and Technology. This Committee principally assists in planning, evaluating, and coordinating unified long-range agricultural research programs and in delineating the appropriate areas of responsibility of Federal and State agencies carrying out these programs.

USDA National Agricultural Research Advisory Committee. An 11-member advisory committee (six of whom are representatives of producers or their organizations) with broad national interests in all phases of agriculture, that evaluates the Department's entire research program and offers suggestions, particularly on policy matters, for modifications, additions, and deletions in the USDA program.

National Advisory Committee on Rural Areas Development. An advisory committee representing agricultural industries, farmers, educational institutions, finance groups and regional representatives that makes recommendations for the greater development of rural areas.

Commodity and Functional Advisory Committees. The 13 commodity and functional Advisory Committees -- authorized under the Research and Marketing Act of 1946 -- offer suggestions on present work, make recommendations on needed future direction of research, and assure more effective communication with the many organizations interested in agricultural research:

- Agricultural Economics Research
- Animal and Animal Products Research
- Cotton Research
- Farm Resources and Facilities Research
- Forestry Research
- Grain and Forage Crops Research
- Horticultural Crops Research
- Human Nutrition and Consumer Use Research
- Marketing Research
- Oilseed, Peanut and Sugar Crops Research
- Plant Science and Entomology Research
- Tobacco Research
- Utilization Research and Development

State Agricultural Experiment Stations. The Directors and designated technical collaborators of the State Agricultural Experiment Stations, in the respective four national regions, assist in planning research activities of mutual interest to the Federal and State groups.

Agricultural Associations and Industry Groups. Advice is sought, and technical and related information exchanged, from all segments of the agricultural industry -- growers, shippers, processors, and distributors -- concerning the many problems of profitably converting agricultural commodities to newer and broader uses.

Consumer Interest. Consumer desires for new and improved products, as well as evaluation of newly developed items, are sought through contacts with consumer groups of national and regional scope. Other USDA groups give assistance in consumer needs and market trends -- Economic Research Service, Federal Extension Service, and market and consumer use research groups in ARS.

Program Dynamics

The Utilization Research and Development program is continuously appraised and reviewed (1) to determine fruitfulness of the research efforts, (2) to discontinue investigations that have reached the point of optimum return or appear unrewarding of useful results, and (3) to direct new or to intensify existing research efforts to meet new needs either by reduction of effort on projects of lesser importance or by new resources that may be available. Examples of such redirected research efforts are:

Research Terminated or Redirected	Research Initiated or Expanded (Made possible by the research terminated or redirected)
<u>Cereals and Forage Crops</u>	
Studies of the composition of wheat endosperm cells	Studies of the mechanism of wheat flour maturation
Studies on physiologically active non-protein nitrogen substances (including bound niacin) of corn	Basic studies on the distribution, amino acid composition, and structure of proteins in different hybrid corns
Search for microorganisms and fermentative process to convert cereal products to xanthophylls for use in feeds	Exploration of microbial spores as fermentative agents for converting cereal grains to industrial products
Basic studies on amino acid and peptide derivatives of starch to impart new properties to starch for industrial use	Exploration of halogen-substituted derivatives of starch as a basis for developing new starch products
<u>Cotton, Wool, and Other Fibers</u>	
Improvement of smooth drying properties, wet crease recovery, and moisture absorptivity in wash wear cotton through swelling treatments	Improved abrasion resistance in cotton fabrics from crosslinking of partially swollen cotton.
Studies of the physical properties of wool fiber assemblages (partially redirected)	Development of new processes to treat wool by electrical discharge energy
Mechanical processing studies to develop new fabrics from coarser grades of wool	Development of blended fabrics from cotton and wool

Research Terminated or Redirected	Research Initiated or Expanded (Made possible by the research terminated or redirected)
<u>Fruits and Vegetables</u>	
Flavor of tomato products (partially redirected)	Texture and consistency of tomato products
<u>Oilseeds</u>	
Engineering studies on production of cyclic fatty acids from linseed oil	Pilot-plant studies on selective hydrogenation of soybean oil with heterogeneous catalysts to produce a flavor-stable, edible oil
Engineering studies on production of aldehyde oils from soybean and linseed oils	
<u>New and Special Plants</u>	
Development of practical methods for preparing the levopimaric acid-formal- dehyde adduct, and the evaluation of this and selected derived products for industrial uses	Conversion of rosin, resin acids and pine gum derivatives into polyols for use in polyurethane applications
<u>Poultry, Dairy, and Animal Products</u>	
Pioneering investigations of allergens in agricultural products	Investigation of the chemistry, anti- genicity and allergenicity of milk proteins, including the effects of enzymes on these properties
Determining the structure of animal fat components and derivatives by physical methods such as infrared spectroscopy and X-ray diffraction	Physical investigation of the funda- mental factors which determine the secondary structure of collagen and other animal proteins
Development of methods for pasteurizing eggs (partially redirected)	Investigation of ability of Salmonellae to resist heat

Utilization Research Projects Terminated in F. Y. 1966

A total of 113 domestic research projects were terminated in F. Y. 1966:

Research objectives attained or substantially attained	92
Research results unpromising or superseded by research of higher priority.	<u>21</u>
Total terminated.	113

In F. Y. 1966, 32 foreign research projects (under P. L. 480) were terminated-- Poland (3); Israel (3); Japan (2); Finland (2); France (8); Italy (4); Netherlands (1); United Kingdom (7); Columbia (1); Uruguay (1).

Utilization Research Projects Initiated or Revised in F. Y. 1966

One hundred eighteen utilization research projects were initiated or revised in F. Y. 1966 -- 91 domestic and 27 foreign projects:

COMMODITY	FOOD USES		FEED USES		INDUSTRIAL USES		TOTAL	
	<u>1/</u> Dom.	<u>2/</u> For.	Dom.	For.	Dom.	For.	Dom.	For.
Cereal grains and forages. . .	4	4	1	1	11	2	16	7
Cotton and wool.	-	-	-	-	25	4	25	4
Fruits and vegetables.	8	-	-	-	-	-	8	-
Oilseeds	8	6	4	-	2	2	14	8
New and special crops.	-	-	-	-	10	-	10	-
Poultry, dairy and animal. . . products.	14	3	-	-	4	5	18	8
Total initiated or revised	34	13	5	1	52	13	91	27

1/ Domestic

2/ Foreign

Summary of Utilization Research Projects for F. Y. 1966

Type	Active at Beginning F.Y. 1966	Initiated or Revised	Terminated	Active at end F.Y. 1966
Domestic	462	91	113	440*
Foreign	168	27	32	163
Total	630	118	145	603

* Includes 16 projects directly supported by industry (fellowships and direct finance support), 191 domestic contract and grant projects, and 9 projects supported by funds transferred from other Federal agencies.

New Research Initiated with Increased AppropriationsCereals and Forage Crops

In-house: Increased work on a comprehensive survey of mold metabolite content in corn, wheat, grain sorghum, and oat samples taken from trade channels.

In-house: Preparation of working samples of aflatoxin for conducting feeding tests with farm animals.

Oilseeds

In-house: Development of suitable processes and processing conditions for inactivation of aflatoxin in cottonseed and peanut products.

In-house: Expanded research on toxin-producing molds and their control.

New and Special Plants

Contract: Bioassay data on physiological activities of cigarette leaf, smoke, and components of leaf and smoke, by standard methods and by improved methods and procedures required as a result of discoveries from research on leaf and smoke.

V CURRENT UTILIZATION RESEARCH PROGRAM

The USDA utilization research and development program is directed to finding new and broadened uses for agricultural commodities through basic, applied, and development research. These efforts currently are devoted to the following areas:

Cereal Grains and Forages. Emphasis on development of new uses for corn and wheat, with continuing investigations on rice, barley, oats, sorghum, and alfalfa and other legume and grass forages:

New and improved food products -- new light-colored food products from whole-kernel cereal grains; improved frozen cereal products through reduction of microbial contamination in milled flours; milk-like products from high protein wheats; new foods by "deep milling" of rices; new fermented wheat foods suitable for improving nutrition levels; new foods by upgrading wheat mill byproducts.

Improved feeds -- upgrading of low-cost milled wheat byproducts to make suitable feed products with low fiber and high nutritive content; studies of various growth factors in alfalfa products; improved coastal Bermuda grass products.

New industrial uses -- new plastic foams and graft polymers from cereal grains for industrial uses; development of better pine plywood bonding materials from soy meal-blood-dialdehyde starch; modified flours for paper improvement; industrial polymers by fermentative processes; factors involved in producing spores of bacterial pathogens useful for controlling Japanese beetle when grown on grain-based media.

Cotton and Wool. New functional properties imparted to cotton and wool through chemical, physical, and mechanical processing research and development, supported by comprehensive fundamental studies of fiber properties and modification:

Cotton chemical processing -- processes to make cotton more suitable for sound barriers and radiation shielding; new ways to improve wrinkle- and abrasion-resistance and drying properties; processes to increase moisture absorptivity to give better wearing comfort to cotton garments; improved coated cotton fabrics with optimum strength-weight characteristics for outdoor uses; durable oil- and water-repellent finishes for cotton; improved luster, strength, and durability of cotton fabrics.

Cotton mechanical processing -- fiber blending procedures to achieve specific properties in finished cotton fabrics; development of a commercially suitable bale-opener-blender; optimal

cotton fabric structures for men's trousers and dress suits; improved sewing techniques (including thread) for wash-wear cotton garments.

Improved wool products -- new soil-resistant treatments for wool based on fluoro chemicals; treatments to enhance luster of wool; new crosslinking agents to give wool dimensional stability at better economic advantages than present Wurlan treatments; studies of wool fabric construction to minimize wrinkling in light-weight wool fabrics; investigations of wool-cotton blends to achieve optimum dimensional stability and appearance during wear and servicing.

Fruits and Vegetables. Development of convenience-in-use fruit and vegetable products, and processing equipment for their economic manufacture, augmented by fundamental investigations on factors affecting color, texture, and flavor:

Citrus and subtropical fruits -- improved quality control methods for lemon juices and lemon oil; new processes for concentration and dehydration of bananas, guava, pineapple, papaya, and passion fruits; studies of flavor constituents of grapefruit products; improved storage and quality of foam-mat dried citrus powders.

Deciduous fruits and berries -- development of new osmosis processes for dehydrating fruit juices to make superior products; new methods for stripping flavor essence for reincorporation in fruit products; methods to control off-odors in canned ripe olives; investigations to overcome sedimentation in apple juices; factors contributing to flavor in avocado products.

Vegetables and potatoes -- quick-cooking whole and powdered lima bean products; new enzyme control methods and drying techniques for tomato products; further improved explosion-puffed carrots, potatoes, and other vegetables; studies to improve quality of processed potato products; new quick-cooking vegetable products by micro-wave heating process.

Oilseeds. Principal research on soybean, cottonseed, and linseed oils, meals, and related products, with additional investigations on castor, safflower, and selected oilseeds resulting from the new crops screening program:

Food uses -- new food products utilizing the recently developed cocoa-butter-like fat from cottonseed oil; processes for making peanut flours, cottonseed flours, and full-fat soy flours, especially for use in developing countries; removal of off-flavor and off-color from safflower oil; continued studies of selective

hydrogenation, particularly for soybean oil; controlling toxic metabolites of mold contaminants in oilseed products.

Feed uses -- studies to improve feed qualities of safflower meal; methods for inactivating or removing cyclopropenes and gossypol from cottonseed meal products; basic information on soybean meal proteins.

Industrial uses -- evaluation of new safflower varieties seeking ratios of oleic/linoleic acids for specific end-uses; new vegetable oil polymers for use in coatings and adhesives; investigations of castor-based urethane foams; aldehyde products from soybean and linseed oil for industrial applications; new protective coating treatments utilizing linseed and soybean oil; preparation and characterization of derivatives of oilseed monomers.

New and Special Plants. Investigations directed to develop compositional data on plants from world-wide sources in an effort to find alternate crops to fill needs not now met by domestic sources, and to develop new and more economic uses for domestic special plants:

New alternate crops -- industrialization of new oilseeds, particularly the processing of erucic acid oils, and the development of chemical derivatives from these sources; processes to improve flavor and nutrient properties of crambe meal for feed purposes; industrial uses for crambe oil and derivatives; evaluation of kenaf for pulping uses.

Naval stores products -- new industrial chemicals from pine gum, turpentine, and rosin.

Culture collection -- enhancement of the ARS culture collection, consisting of 17 thousand permanent cultures, used for commercial manufacture of antibiotics and other pharmaceuticals, insecticides, and industrial products.

Tobacco -- broadened program to emphasize studies of biologically active compounds in tobacco leaf and smoke, determination of products formed on burning leaf tobacco, effect of added chemicals on smoke composition, and development of rapid bioassay methods and measurement of tobacco smoke condensates by these methods.

Other crops -- improved techniques for manufacturing maple and sorghum sirups.

Poultry, Dairy, and Animal Products. Development of better and more economical food products from poultry, eggs, milk, and meat, and development of new industrial outlets for fats, hides, and other animal, dairy, and poultry byproducts:

Poultry products -- structural changes in poultry meat induced by variations in aging, freezing, thawing, cooking, and related food processing steps; new processes for continuous freeze-drying of raw and cooked chicken meat and other products; factors affecting flavor of cooked poultry meat.

Egg products -- effect of pasteurizing techniques upon egg components and contaminants such as Salmonella; factors contributing to Salmonella contamination in egg products; methods for elimination of Salmonella from egg products by chemical treatment; chemical, physical, and enzymic means of altering functional properties of egg white leading to new products.

Dairy products -- constituents responsible for stale flavor in dried and concentrated milks; mechanisms for antigelling properties of milk concentrates; improved vacuum-foam-dried whole milks; further improved processes for cheese-making, particularly for enhancing flavor and slicing properties; preparation of anhydrous milk fat and ghee for new food uses; processes to make ultra-high (70-80% solids) milk concentrates.

Meat products -- new formulations and methods of preparing smoked meat products; time-temperature tolerance studies of frozen meat products; methods for modifying flavor, color, and aroma constituents of meat products; curing organisms that produce flavor changes in cured meat products.

Byproducts -- new lubricants and biodegradable detergents from chemically modified fats; further uses for glutaraldehyde tanning for leathers; regenerated collagen products from animal hide materials; dehydration processes for preserving animal hides for processing.

VI FINANCIAL INFORMATION

The F.Y. 1966 and F.Y. 1967 domestic utilization research and development funds under "Salaries and Expenses, Agricultural Research Service," including allotments from the Special Fund for additional labor, are as follows:

	F.Y. 1966 (Obligations)	Proposed Distribution F. Y. 1967 (Estimated)
Cereal and forage crops	\$ 6,607,922	\$ 6,611,800
Cotton, wool and other fibers..	5,813,847	6,046,000
Fruits and vegetables	4,378,589	4,897,000
Oilseeds	3,904,780	4,098,000
New and special plants	2,625,872	2,919,900
Poultry, dairy, and animal products	<u>6,368,351</u>	<u>6,504,400</u>
Total	<u>\$ 29,699,361 a/</u>	<u>\$ 31,077,100 b/</u>

a/ Includes funds appropriated under the Second Supplemental Appropriation Act, 1966, for increased pay costs pursuant to Public Law 89-301 and wage board increases.

b/ Excludes amounts needed to meet pay costs pursuant to Public Law 89-504 and wage board increases.

In addition to the 1966 total shown above, \$65,250 was obligated under nonrecurring allocations from the Contingency Research Fund for investigations on methods for processing dates which have been mechanically harvested and conducting dairy and beef cattle feeding trials to determine whether certain contaminants are transmitted through feeds into meat, milk, and eggs.

The 1964 Appropriation Act authorized use of the following funds for construction that has been completed or will be completed in the near future.

1. <u>Transfer of CCC Funds:</u>	<u>Amount</u>	<u>Estimated Completion Date</u>
California, Albany	\$ 1,550,000	October 1967
Florida, Olustee	250,000	Completed 10/1/66
Illinois, Peoria	4,500,000	April 1968
Louisiana, New Orleans	1,465,000	August 1967
Pennsylvania, Wyndmoor	1,485,000	June 1967
Texas, Weslaco	250,000	Completed 10/31/66

	<u>Amount</u>	<u>Completion Date</u>
Survey, determination of need, and planning of additional re- search facilities as may be required for utilization re- search in the Southeast and weed control research, not to exceed	<u>250,000</u>	See Athens, Ga. below.
Total, UR&D Construction	<u><u>\$ 9,750,000</u></u>	

2. Section 32 fund transfers authorized for:

Georgia, Athens - Construction of Southeast utilization research and development laboratory	\$ 9,500,000	December 1968
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In addition to the domestic program, the equivalent of approximately \$641,749 in foreign currencies was obligated in F.Y. 1966 for utilization research projects (largely extending over a five-year period) conducted under agreements with foreign institutions. This work is financed by funds generated under the P.L. 480 program.

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The total of \$31,077,100 estimated to be available for fiscal year 1967 includes approximately \$4,100,000 of Section 32 funds transferred to and merged with our Salaries and Expenses as provided in the 1967 Appropriation Act. Transfers from Section 32 funds were provided previously in fiscal year 1965.

The F.Y. 1967 Appropriation Act also provides for the following changes:

	<u>Increases</u> \$	<u>Decreases</u> \$	<u>Total</u> \$
Staffing and operating new and expanded research laboratories:			
Albany, California.....	+ 50,000	--	+ 50,000
Olustee, Florida.....	+253,900	--	+253,900
Winter Haven, Florida....	+202,900	--	+202,900
Athens, Georgia.....	+25,000	--	+25,000
Peoria, Illinois.....	+43,400	--	+43,400
New Orleans, Louisiana...	+50,000	--	+50,000
Weslaco, Texas.....	+216,300	--	+216,300
Nonrecurring operating costs of certain research proposed for closing prior to June 30, 1965, for which it was necessary to incur costs in 1966:			
Albany, California.....	--	- 32,300	-32,300
Houma, Louisiana.....	--	-1,000	-1,000
New Orleans, Louisiana...	--	-9,000	-9,000
Philadelphia, Pennsylvania	--	-22,600	-22,600
Prosser, Washington.....	--	-8,700	-8,700
Portion of general reduction of \$78,000	--	-15,700	-15,700
Accelerating processing re- search on mechanically har- vested dates	+40,000	--	+40,000
Increase to provide for full year pay costs in fiscal year 1967 of the pay increase pursuant to P.L. 89-301 ...	+189,600	--	+189,600
Total change	+1,071,100	-89,300	+981,800

VII SELECTED RESEARCH ACCOMPLISHMENTS

Soy flour process for use in developing countries. A favored approach for alleviating food shortages in the developing nations is to provide low-cost



Full-Fat Soy Flour Process

For Local Use
in Developing Countries



protein foods based on crops that can be grown locally. To help meet this objective, Department engineers have devised a simple method for production of full-fat soy flour. The process is designed for use in foreign villages where skilled labor, electric power, and steam are not available. In this process, both equipment and fuel requirements are minimal and hand labor is used wherever possible to replace mechanical power. Cost of equipment capable of producing 300 pounds of full-fat soy flour per 8-hour day is estimated to be less than \$200. This

production, which can be accomplished by five men, is sufficient to supply 35 grams of protein per day (one-half the minimum daily protein requirement) to more than 1,600 adults. The remaining step to be taken is on-site demonstration of this simple flour process to the environmental conditions of a specified developing country.

New industrial chemicals from castor oil. Highly efficient methods have been developed in USDA laboratories for converting low-cost hydrogenated castor oil esters to ketostearate esters, which have unique physical and chemical properties that should make them industrially valuable. Inexpensive catalysts rapidly and completely convert castor esters to ketostearates. Processing costs are only a few cents a pound. Several companies are evaluating these ketostearates for such uses as permanent-type automotive lubricants and mold-release compounds. The latter are mixed with polyethylene so that molded products such as phonograph records are released quickly and easily from the mold without sticking. One industry spokesman foresees an immediate yearly market for several million pounds of ketostearates in lubricant applications. Another large producer has embarked on an extensive exploratory research program to develop uses for ketostearates, now that they can be prepared by this low-cost method.

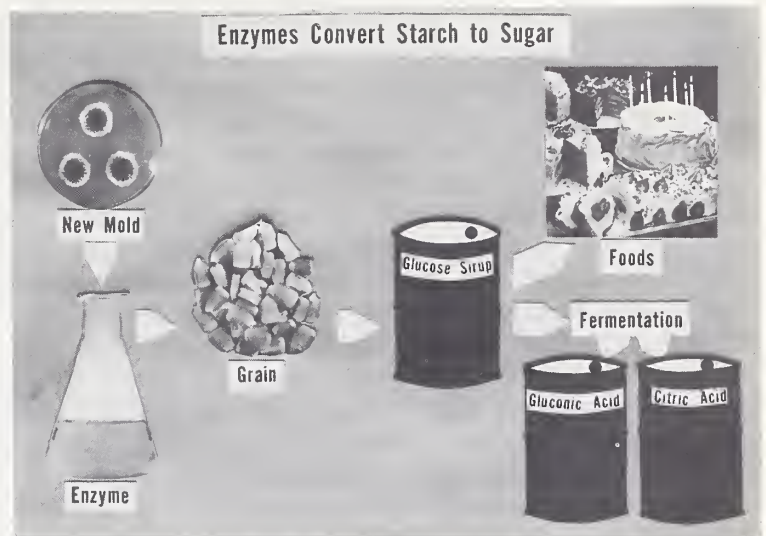
Food-protein concentrates from wheat mill fractions. Department research has shown that high-quality food ingredients can be made from bran and shorts, by-product fractions produced when wheat is milled into flour. These by-products previously have been sold as animal feeds, but now up to 50% of this material can be recovered as food-grade flours or upgraded feeds. In the new process, the bran and shorts are dried and remilled separately in conventional flour milling equipment. The resulting flours contain 25 to 40% protein and only 2 to 4% fiber. The biological value of the protein is high because it contains more than 4% of the scarce amino acid lysine. At least six major flour milling companies are using these USDA discoveries to develop such new products as high-protein, general purpose flours and nutritionally enriched gruels and beverages to supplement protein-deficit diets. Sufficient mill by-products are available so that nearly two million tons per year of these high-protein concentrates could be recovered for upgraded and higher return uses.

USDA wheat gluten process commercialized. A continuous process has been developed by Department scientists for separating wheat flour into starch and food grade gluten. The process is simple in operation, and no addition of chemicals is required. Five U.S. industrial installations are using this procedure, or modifications of it, to process over 265 million pounds of flour annually. A sixth plant, now nearing completion in the Pacific Northwest, will produce different grades of starch and food grade gluten, as well as conversion of starch into sirup. Gluten, presently totaling more than 25 million pounds annually, has many important uses such as increasing the protein content of flours for baking and increasing the protein level of breakfast cereals. Wheat starch -- currently amounting to over 200 million pounds yearly -- has broad use in foods and such industrial uses as paper additives, wallpaper pastes, and plywood glue additives.

Vital Wheat Gluten Improves These Foods



Lower cost sirup from cereal grains. Industry is now extensively using a process developed by Department scientists for the conversion of the starch in whole cereal grains to low-cost-sirup by the use of bacterial and fungal enzymes. The sirup produced by this enzymatic treatment makes it possible for cereal grain products to compete with imported molasses used in the fermentative production of chemicals and antibiotics. Annual U.S. consumption of molasses during 1962-1965 ranged between 589 and 645 million gallons, of which 264 to 270 million gallons were imported. On a refined molasses basis -- and



nearly all uses for molasses require refined grade -- this new USDA process would permit this country to produce sirup from corn competitive with molasses presently imported. This usage would afford an additional outlet for as much as 45 million bushels of corn or other cereal grains.

New uses for starch in urethane foams. Department scientists have developed a new process for making polyethers from starch for use in the production of rigid urethane foams. Rigid urethane foam from all sources is now being sold at a rate of 100 million pounds per year with forecast of 280 million pounds by 1969. The increasing demand is due to the high insulation capacity of these foams, with the construction, transportation, and appliance industries being the major consumers. A complete technical report on the production, use, and cost of these new foams (based on extensive pilot plant investigations) has been supplied to more than 125 industrial and technical inquirers. Many companies have made pilot-scale trials of the process with satisfactory results. The outlook is most encouraging for a significantly large new outlet for cereal starch in this application.

Industry uses acid-modified cereal flours. USDA researchers have developed a process for the chemical modification of cereal flours for use in paper products. Four large milling companies are selling the acid-modified flours (AMF) made from corn or sorghum for use in paper sizing and gypsum board. All are using either the Department's process or a modification of it. Results in commercial paper mill trials on surface sizing of laminated fiberboard have been so successful that a soft-wheat flour milling company is planning to install a small plant to make AMF. Cost of the modified flours is favorable; however, no figures are presently available for current sales of AMF. The paper industry currently uses 600 million pounds of corn and sorghum products per year for surface sizing, and the gypsum board industry uses over 50 million pounds. Increased use of AMF is expected to develop largely in the coarse paper and box paper industry. The outlook is good, particularly in regions where flour and paper mills are in close proximity.

New weather-resistant finish for cotton. Research carried out by Department scientists in cooperation with the Canvas Products Association International and the Foundation for Cotton Research and Education has led to the discovery of an excellent colorless weather-resistant finish

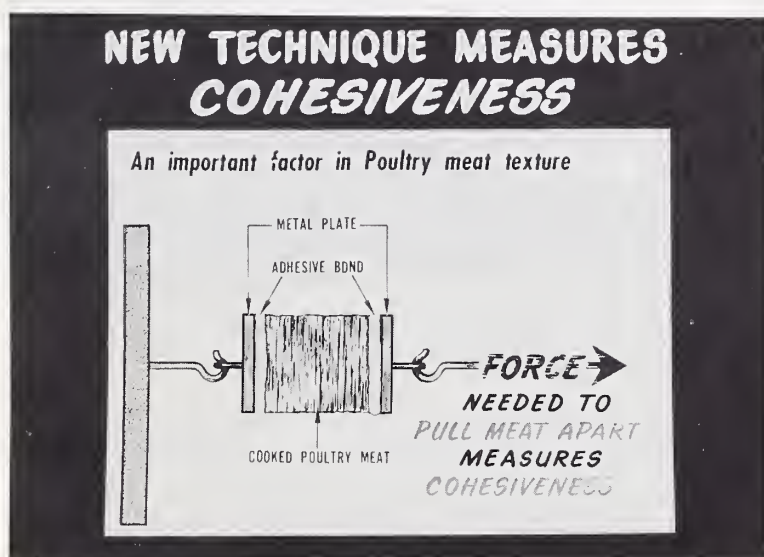
for outdoor cotton fabrics. Based on commercially available chemicals (trimethylolmelamine and zirconium acetate), the new finish is highly resistant to microorganisms that usually attack and quickly destroy cotton. It was developed primarily to increase the service life of cotton fabrics used in coated products, and its lack of color makes it particularly desirable for white or light-colored coatings. Cotton fabrics treated with the finish and coated with a pigmented vinyl coating are still retaining 100% of their



original strength after 24 months of outdoor weathering in the warm, moist climate of New Orleans. This excellent performance should make the fabrics very attractive to industry for broader use in awnings, truck and boat covers, tarpaulins, tentage, and other canvas products, a market currently utilizing about 120 million square yards of cotton fabric annually in this country. At least three manufacturers are actively considering the new development.

SRRL cotton fiber retriever widely adopted. A simple, inexpensive, newly designed cotton fiber retriever has enjoyed phenomenal commercial adoption since its development in 1963 by USDA engineers. By the end of 1964 over 2,000 units were estimated to be in use. Of the fifteen companies licensed under USDA patent covering the SRRL Retriever, by mid-1966 over 8,000 units had been produced by the four major manufacturers. Total present use is understood to be about 10,000 units. The new retriever increases cleaning efficiency in the mote box by 40 percent; increases overall efficiency of the cotton card by about 12 percent; and reduces the short fiber content of the card web. Another index of industry interest was reflected at the 1965 American Textile Machinery Exhibit International where all domestically manufactured high-speed cards were equipped with the SRRL Fiber Retriever.

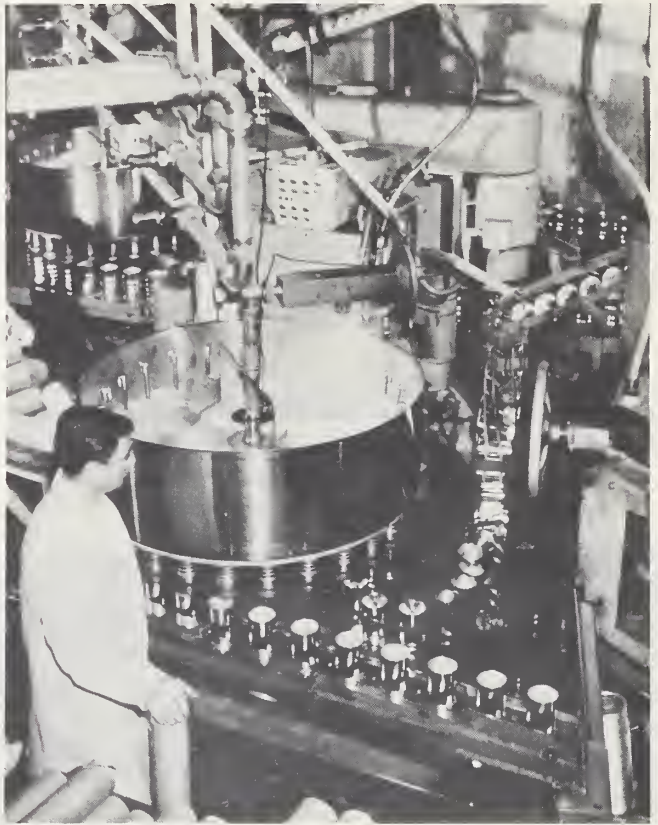
Measuring cohesiveness in poultry meat. A method has been developed for the mechanical measurement of the cohesive force holding fibers together in poultry meat. It provides, for the first time, an objective measurement



of a texture defect sometimes found in canned, freeze-dried, and irradiated meats associated with an undesirable crumbly, cottony feel in the mouth. Adequate cohesiveness is recognized as essential for good texture in meats. The method employs standard tensile testing equipment and an adhesive compound that forms a bond between metal and poultry meat stronger than the cohesive force within the meat. Cohesiveness measured by this method correlates well with the degree of degradation of the connective tissue protein, collagen.

This method for measuring cohesiveness, plus the shear force method of measuring tenderness, provides two valuable tools for research to improve the texture of processed poultry products.

New method for controlling citrus juice quality. The recent development of a new method of estimating the volatile oil in citrus juices is filling a real need in the processing industry. Previously, it was very difficult to maintain optimum limits of peel oil, a necessary component of flavor in the juices, because the existing official grading method took as long as 90 minutes to complete -- during which more than 100 tons of fruit can be processed in an average plant. In contrast, the new method takes only five to seven minutes to complete; is more accurate (measures practically all the volatile oil); is extremely precise (reproducible to within 0.001% oil); and is simple enough in both apparatus and procedure to permit routine use by processors. Over fifty percent of the citrus plants in Florida, California, and Texas are presently employing this new control method, with broader adoption anticipated in the next processing season. USDA inspection service has already accepted it as an alternative standard procedure, attested to by certification.



Processes for Mechanically harvested red tart cherries. The application of basic knowledge -- developed by USDA utilization researchers -- of the effects of bruising, delay, and temperature on cherry quality has materially aided in assuring high-quality processed products made from mechanically harvested cherries. The new processing method, plus scarcity of farm labor, is causing mechanical harvesting to increase rapidly. In 1966, 250 machines harvested 50 million pounds of cherries (25% of the total crop), compared with 7% for 1965, with a total saving of over 1.5 million dollars. Extended to the entire United States red tart cherry crop, mechanical harvesting could mean a total saving of some \$7 million annually at present production levels.

New WURLING evaporator for fruit and vegetable processing. Thick fluids, like tomato paste and fruit preserves, are difficult to concentrate be-



cause they foul the evaporators with burned or stuck material. Through basic research, Department engineers have designed the WURLING evaporator for concentrating such thick and heat-sensitive fluids. A rapidly whirling coil is completely submerged in the liquid under vacuum. By operating under vacuum, low-temperature steam can be used in the coil, thus permitting accurate temperature control and preventing the development of hot spots. Fouling is minimized and quality of the product is preserved. One processor is using a WURLING evaporator that can produce 4.5 tons per hour of tomato paste with 50% solids and having excellent color and flavor. Another processor is making high-quality fruit preserves with a WURLING evaporator. Cost savings are considerable because the WURLING evaporator doubles output at less than half the cost of conventional thin-film evapora-

tion. One equipment manufacturer is presently making the WURLING evaporator, and others may be in production soon.

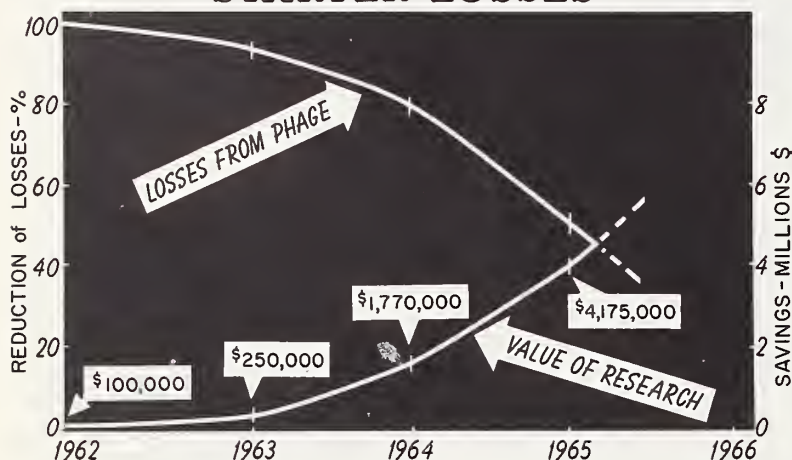
Biodegradable liquid detergents made from tallow. Department scientists, seeking another outlet for surplus inedible fats, have developed biodegradable liquid detergents from tallow. These products have excellent properties in heavy-duty liquid detergent formulations. One form of these new detergents is an excellent lime soap dispersing agent and can be used in liquid soap-detergent combinations for hard water use. More important, the tallow-based detergents have the advantage of a higher degree of biodegradability than petroleum-based detergents. In anerobic digestion systems, where petroleum-based detergents show no degradation, some of the new fat-based formulations will break down completely, and in aerobic sewage processes the new tallow-derived detergents are at least equal in biodegradability to the petroleum counterparts. Within the past ten years, liquid detergents have proved their usefulness and popularity. At today's production levels, 1400 million pounds of these products account for 33% of all detergent sales. Although not yet in commercial production, tallow-derived liquid detergents are considered relatively inexpensive to manufacture and should be in a good competitive position from the standpoint of costs.

Improving freezer-stored meats. During periods of peak production, the meat industry annually freezes millions of pounds of meat worth several billion dollars. The high quality of this meat could be extended and the economy and convenience of frozen retail meats could be better utilized if deterioration of the fat portion could be prevented. For some time, scientists have known that one type of fat deterioration results from the activity of enzymes that are produced by bacteria. Although these enzymes are produced at above-freezer temperatures, their activity, unlike bacteria, persists after the meat is frozen. A definite fat breakdown is often noticeable after only 30 days at -20°F . Department researchers have discovered that the enzymes, released from bacterial cells, circulate widely throughout the meat where they freely attack the fat, with each bacterial specie producing different enzymes that degrade fat in various ways. This detailed understanding of fat deterioration will be valuable in developing improved procedures in the freezer storage of meats. Data from this research also will be used to select optimum temperatures for curing processes where specific desirable flavor changes may be induced by controlling the storage temperatures.

Improved cheese processing. Formerly, many of the bacterial cultures used in cheesemaking were easily contaminated by bacteriophage -- a virus that attacks the bacteria, interferes with its growth, and prevents formation of the acidity required.

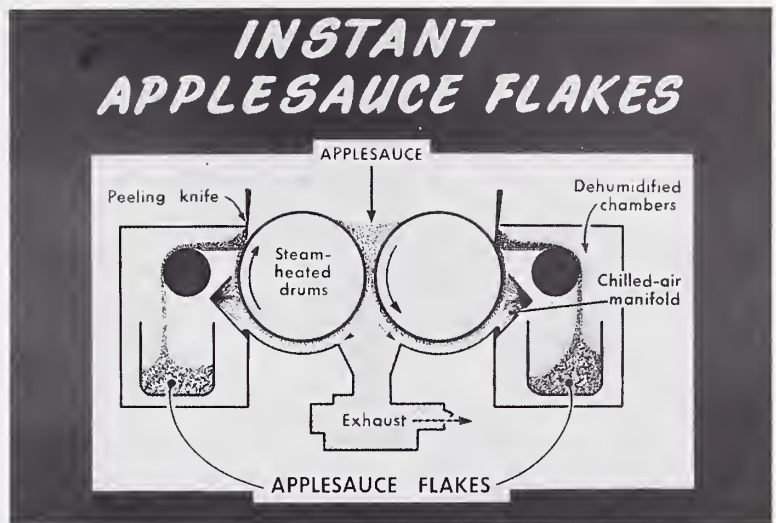
A new method developed by Department scientists now prevents bacteriophage growth and activity. The new method is used widely by industry, particularly by Cheddar cheese manufacturers and by cheese culture supply houses. It is estimated that the savings from use of this method in 1964 amounted to \$1,770,000 and in 1965 to \$4,175,000. In other investigations, scientists in Poland, working under a P.L. 480 grant, have developed several promising mold strains

REDUCTION IN CHEESE STARTER LOSSES



for use in making Roquefort and Camembert-type cheeses with increased vitamin B content. One new strain in particular (*Penicillium roqueforti*) has remarkable vitamin B-synthesizing abilities. It produces good quality Roquefort cheese which contains about 60% more vitamin B₂, 30% more vitamin B₆, 60% more pantothenic acid, and 50% more biotin than cheese made from conventional strains. These new cultures appear to have considerable commercial promise.

Instant applesauce flakes. A new convenience food, instant applesauce flakes, is now in commercial production. One company, with orders exceeding its production capacity, is preparing to double its output next season. Other companies are investigating installation of the modified drum drier developed by Department engineers for drying applesauce and other fruit purees. A chilled air blast, used to facilitate the removal of the flakes from the hot drum surface, speeds production and reduces heat damage. Production costs are low because drum drying is one of the simplest and least expensive of drying methods. The flakes reconstitute quickly in cold water to make an applesauce of excellent flavor, color, and texture. Also, the flakes can be used in cake mixes, baked desserts and pastries, candy and apple butter, and as fruit in breakfast cereals. The new product meets a long-standing need as a military ration item. Recently, the product, because of its high quality and good acceptance, has been used in manned space flights.



Linseed oil protection for concrete. Use of salt for ice and snow removal has caused increasing damage to concrete highways under winter conditions. Department scientists cooperating with industrial, Federal, State, and local groups have demonstrated that thin coatings of linseed oil help protect concrete against scaling and spalling caused by weather exposure and de-icing chemicals. The oil may be applied as a solution of oil-mineral spirits or as a Department developed oil-water emulsion. The merits of the linseed oil treatment have been so convincingly established that a number of States now provide for such treatments on bridge decks and associated curbs and walks. The Bureau of Public Roads (U.S. Department of Commerce) has recently endorsed this use as well as for new concrete pavements, particularly those placed in the late fall. Country-wide adoption of this practice would result in greatly increased consumption of linseed oil, an important crop in the States of Minnesota, North Dakota, South Dakota, and Texas. For example, in 1965 the State of Illinois used 400,000 lbs. of linseed oil on concrete bridges, with some application to highways. Illinois usage -- with greater emphasis on highway use -- is expected to be at least one million pounds in 1966.

More markets regained for leather. Shearlings--sheepskins tanned with the wool still attached--are now made commercially by tanning with glutaraldehyde in a process developed by Department scientists. Shearlings are used principally in paint rollers and in hospital bed pads for the cure and prevention of bed sores, but present types have serious deficiencies.



Hospital pads made of the improved glutaraldehyde tanned shearlings give longer service and have greatly improved launderability. Paint rollers of the new shearlings resist the deteriorative action of water-based latex paints, thus giving better performance, longer life, and easier cleaning. The largest tanner of shearlings has adapted the USDA process to his operation and has been in full-scale production for over a year. This success has stimulated other tanners to evaluate the process in their production. It

is estimated that in 1965, the first full year of commercialization, the retail value of shearlings treated by this process for use as paint rollers and bed pads was about \$5.6 million. Promotion of the new and improved shearlings is being conducted by the manufacturers and the International Wool Secretariat, through its Wool Bureau. The potential, if realized, may conceivably strain the supplies of rawstock and the manufacturing facilities.

